

ries and diseases associated with numerous chemical, biological, and physical hazards.

Occupational Lung Diseases

In 1988, agriculture had the sixth highest work-related lung disease rate in this country. Types of lung diseases ranged from: allergic, to asthma and acute responses to toxic or irritating grain fumigants.

Musculoskeletal Disorders

Another disease entity that is prevalent is degenerative musculoskeletal disorders. They result from chronic exposure to farm machinery vibrating, or to repetitive trauma associated with farm work. The most noticeable for these are reported as low back pain, hip arthrosis, and degenerative arthritis of the knee and upper extremities.

Migrant workers are typically involved in work that involves frequent hand and wrist movements, awkward working positions, and a dependence on manual lifting, which may be conducive to carpal tunnel syndrome and low back injuries.

Occupational Cancer

Regarding cancer, epidemiological studies of farmers have uncovered consistent excesses of hematologic cancers, including leukemia, Hodgkin's disease, non-Hodgkin's lymphoma, and multiple myeloma, as well as cancers of the lip, skin, stomach, prostate, and brain.

Causative agricultural exposures have not been conclusively identified, but agents of concern include nitrates, pesticides, viruses, antigenic stimulants, and various fuels, oils, and solvents.

Excess cancers of the lip and skin are linked to increased exposure to the sun's ultraviolet radiation.

Severe Traumatic Injuries

Severe occupational traumatic injuries usually occur suddenly on the job and are either fatal or require immediate medical care. These injuries affect, in substantial numbers, children under the age of 16 and the elderly 65 and older.

Machinery, especially farm tractors, are a major cause of death to agricultural workers. Others result from inadequate farm building design and livestock handling.

Of the estimated 1,500 machinery-related deaths annually among all occupations, more than half involve farm equipment.

Cardiovascular Diseases

Another serious disease associated with agriculture is heat stroke. Agricultural workers are at the highest risk of developing this compared to all other workers, including miners and construction workers.

One associated risk factor is the lack of available drinking water, which affects at least one-fifth of labor-intensive farmwork nationwide.

Reproductive Disorders

Workplace exposures can adversely affect the male and female reproductive systems, and as a consequence interfere with fetal development, and children's health. Pesticides may cause reproductive failure in either men or women, genetic damage, or miscarriage.

Moreover, the nature of agricultural work and the physiological changes of pregnancy put the pregnant farmworker at increased risk of health problems for both herself and her baby.

Neurotoxic Disorders

Neurotoxic disorders present problems for the farmers as well. Approximately 10,000 people in this country suffer acute poisoning by organophosphate insecticides annually. These pesticides affect the nervous system, and up to not, the long-term neurologic consequences are known.

Noise-Induced Hearing Loss

Regarding noise, noise-induced hearing loss is a well-documented result of exposure to farm machinery noise, especially tractor noise. Approximately 323,000 agricultural workers are exposed to potentially hazardous noise levels. Such hearing loss has been found to affect a quarter of younger farmers and fully one-half of older ones.

Significant numbers of those affected have been found to develop a communication handicap by age 30.

Dermatological Conditions

Epidemiological data indicate that dermatological conditions caused by ultraviolet radiation, plant materials, soils, fertilizers, pesticides, and agents causing zoonotic infection are very common among United States farm workers.

In 1984, these disorders comprised over two-thirds of the occupational illnesses among crop production workers.

Skin disorders in this group were over five times more common than among all private sector employees combined, and nearly three times that of manufacturing employees.

Psychological Disorders

Additionally, farmers, farm family members, and other rural inhabitants are not exempted from stress-related psychological disorders, especially depression.

Some of these psychological disorders appear to be related to isolation, economic hardship, weather conditions, or labor status.

Infectious Diseases

In addition, some infectious diseases, which are agriculture-related, vary from one part of the country to another. Some others, such as those related to poor sanitation, like dysentery, hepatitis, typhoid fever, and intestinal ailments, are commonly spread by using the same eating and drinking utensils, drinking non-potable water, and from fecal-oral contaminating due to the lack of toilet and handwashing facilities.

Others, like parasitic infections — estimated to be 20 times that of either the general U.S. population or even other rural or poor urban populations, are epidemic among migrant farm workers.

Such is also the case for tuberculosis. For migrant workers, this is an occupational problem, and not an imported disease. The disease is 3,000 times more prevalent among black migrants than the general population as a whole.

So now that I have disseminated the information, and you are aware of the problem, what do we do?

First, and most importantly, parents who farm need to know what the dangers are. Second, parents must then educate their children about these dangers. Ignorance—like knowledge can remain forever.

The country is ready and the time is ripe to move the national agenda forward regarding injury control. The key to any success we might realize, however, lies in our ability to come together, first at the local level, and then at the Federal level.

And this is why we are here today—to explore what is needed to facilitate and promote this common goal, and work together in making it a reality.

In order to accomplish this, we need to return to some of the basic aspects of public health and management.

- We must work to raise the consciousness of the public and alert the community leaders about critical issues.
- We must also build coalitions—partnerships between health, education, environment, labor, and agriculture communities.

We must begin to disseminate the appropriate information, and we must as a consequence of such information, encourage action to prevent injuries.

Ultimately, my goal is to motivate all of you to reduce agriculture-related diseases and injuries, by prevention.

If we are to be successful in this endeavor, we must tackle the problem head on.

My wish is that this Conference will set a milestone in saving lives and preserving health. To accomplish this, Dr. Millar and I hope to convene a follow-up conference in the near future to develop a national strategy for the prevention of agricultural-related diseases and injuries.

But until then I must tell you that it is my belief that in agricultural safety and health, prevention begins and ends with the family, and so, the family should be one of our main targets as we fulfill the charge I have given to this Conference.

The key to any success we might realize, however, lies in our ability to come together, first at the local level, and then at the Federal level.

There was a famous 19th century Puerto Rican literary figure, Eugenio Maria de Hostos, who considered the family to be the cornerstone of society. He said:

...as members of a family, we are so closely bound to it by gratitude that we recognize its effects from the cradle to the grave. If we are born, we owe it to the family; if we grow up, it is through the protection of the family; if we are educated, it is the work of the family; when we are with the family we work for it, away from it we long for it; we are happy in the family and for its sake; if we are unfortunate, we regret it for the sake of the family; ill, we fear death for its sake, and in dying, we long for it.

With all this in mind, your deliberations here will set the stage for the work that needs to be done in this field. You have the responsibility of building a firm foun-

dation for our future actions in the coming decade. Your networking and coalition building will set the partnerships that need to be maintained.

This may be the tenth Surgeon General's conference on occupational safety and health, but this is just the beginning of our work together.

Appropriately enough, today, May 1st, is traditionally viewed in agriculture as a "day of fertility." Hopefully, today will mark the day for our National Coalition for Local Action to grow stronger. I trust that will be the case.

We know that changes do not come easy—they take commitment, partnership, and dedication.

It is apparent to me that this group is serious about injuries, and their impact on the lives of all our citizens.

It also seems to me that we know what to do and how to do it. Now we, together, must do it.

Only when this is done will this local action serve the national purpose. Friends, this is our "Field of Dreams." If we build it, they will come. I know we can, I know we will.

Thank you, and God Bless.□

REMARKS BY THE NATIONAL FFA PRESIDENT

By Mark Timm
President, National FFA Organization

Dr. J. Donald Millar: One of the great things about this conference to me is that there are so many young people here. We are very, very pleased with that aspect, and oftentimes in public health meetings there are not a lot of young people around. It seems to me that we have not made prevention and public health all that attractive to young people. But this is a field that compels the imagination of youth as well as the rest of us. So it is a great pleasure for me, at this point in the conference, to introduce you to a young national leader, Mark Timm, who is the national president, FFA. Mark is president for 1990-91. He is 19 years old, and he serves over 387,000 FFA members in over 7,600 local chapters nationwide, including the District of Columbia, Puerto Rico, and the U.S. Virgin Islands. These FFA members are preparing for careers in the science, business, and technology of agriculture. Mr. Timm was State FFA president in Indiana last year and is a National FFA scholarship recipient. He is currently on a one-year leave of absence from Purdue University—my wife and I drove through West Lafayette just two days ago—where he is studying sales and marketing with sights on working for an agricultural company in the future. During his year as FFA president, he will travel more than 200,000 miles, making hundreds of appearances on behalf of the FFA. It is my very great pleasure to introduce Mark to you:

OPENING REMARKS

Good morning, and thank you for that kind introduction, Dr. Millar.

It is a pleasure to be here. I have a background similar to that of many people who have taken this podium. Senator Harkin stood up here and said he was from a small town.

Well, I am also from a small town, the town of Fillmore, Indiana, a rural community. Sometimes when I am talking across the country, in cities such as Los Angeles, Oklahoma City, Iowa City, talking about a small town, I say, "You know Fillmore is so small that when you drive into Fillmore there is no need for a turn signal because everybody knows where you are going anyway."

I think it is one of the few places in the country that you can dial the wrong number and still talk for thirty minutes. Many

of you can probably relate to what I am talking about.

But, I am from a rural community, and I can stand up here, as many have, and relate to you story after story of my experiences with working with agriculture—the experiences of discing a 100-acre field at the age of 10, or planting at the age of 11, or maybe even driving a grain truck with 7½ tons of grain at the age of 14.

I will be honest with you: at that point in my life I did not give it a second thought.

By the same token, most of you involved in agriculture know that it is a way of life, and it is a respected way of life. I feel that the objectives being accomplished here and the directions that we are heading are definitely right.

Dr. Millar, you talked about my involvement in the FFA. The FFA is the nation's largest intercurricular student youth orga-

nization—nearly 400,000 FFA members nationwide. And serving as national president is a tremendous honor. It is a great opportunity, but it is even a greater responsibility, because, as the speakers have stood up here and talked about the role of youth in America there are not very many opportunities for youth to speak out and speak to adults.

I have been given the chance to represent a large portion of the youth in America and the youth in agriculture. It gives me great delight to see the young people in our organization out here. I do not know if you have had the chance to notice, but there is more than just my jacket running around here. There are seven chapters from all across this country.

Dr. Roper talked about leadership. Well, our organization is based on agriculture. That is the backbone of this organization.

But, equally important, our students are interested in developing their leadership, their personal, and their academic skills, through agriculture. We are teaching them not only to be stewards of the land but to be the future leaders of our communities, of our state, of our country, and eventually even of our world.

I would like to share with you some of the leadership that we are showing in the area of safety. We have a National Chapter Safety Award Program.

This year, at our National Convention, we honored over 150 chapters for outstanding accomplishments in the area of safety. Thirty-six chapters received gold recognition, and out of those 36, seven were chosen to attend this conference. Those seven chapters are going to be putting on poster

displays tomorrow afternoon in the poster display demonstration.

I want to share with you, just to highlight some of the safety areas that we work on or that we address as an organization, because, you see, our primary goal as a national safety award program is just like the goal that your theme states. It is a national coalition for local action.

This year, at our National Convention, we honored over 150 chapters for outstanding accomplishments in the area of safety.

It is a national award program centered at the local level. What we do is assess the needs of the community. The chapter assesses the needs of the community, and some of those needs that we address are National Farm Safety Week; Farm Safety for Just Kids, which you have heard about; chemical safety for farmers; water quality testing; and all-terrain vehicle (ATV) and three-wheeler seminars.

Chapters even address areas such as boating safety; holiday awareness programs such as the testing of candy on Halloween; fire-prevention safety; home safety, farm machinery operations, and hazardous grain hauling; chain-saw safety; restricted use for pesticides; CPR classes and substance abuse awareness. So, we are touching several areas in safety, focusing primarily on agriculture, which is our backbone, but also other areas of safety.

Not only do we have our National Safety Award Program, but we also are infusing safety into our curriculum—agricultural education. We have initiated programs in areas such as food safety and environmen-

tal safety. As a matter of fact, one of our most recent programs was food safety—a \$300,000 project that business has picked up and is willing to sponsor, and we plan to start developing the actual curriculum this summer.

We will be writing the curriculum and will be spreading it across the country, with 400 workshops, trying to educate our teachers of agriculture education and the home economic teachers about food safety, all the way from the production of food to the processing of the food. So we are covering a wide range, a wide spectrum, of food safety. We will educate teachers on food safety, then they will educate the people that make it count, and that is the young people in America.

I would like to close on my statements about the FFA and our role in safety by quoting what one of the chapters that are represented here—the Stockton Chapter of Missouri—said in their safety award application:

*Health is not everything,
but you're dead without it.*

[REMARKS AFTER THE FIRST SPEAKER]

The rest of this session will frame the work of the conference around three activities: surveillance, research, and intervention. Each of the three following speakers will pose questions related to each of these activities, which will be addressed by five concurrent sessions.

One session will address surveillance; two will address research; and two will address intervention. These five concurrent sessions will convene this afternoon. The five sessions are:

1. Surveillance—Agriculture-related Disease, Injuries, and Hazards.
2. Research—Biological and Chemical Hazards.
3. Research—Physical and Mechanical Hazards.
4. Intervention—Agricultural Workers' Protection from Hazards.
5. Intervention—Safe Behaviors among Adults and Children.

A presentation panel will deliver talks on a variety of issues. Tomorrow, after a morning plenary session, a concurrent session will reconvene to hear discussion panels comment on today's presentations. The concurrent session will reconvene again after lunch tomorrow, to hear public comment and to address the points to be reported back to the full conference on Friday morning.

[REMARKS AT THE CONCLUSION OF THE SESSION]

Before we conclude, I would like to thank them for giving me the opportunity to come here, and I would also like to say that, as the population of the rural community declines, so does our membership in the FFA, the organization that I represent. However, our urban membership has drastically increased, so we are involving a much more diverse group of young people interested in agriculture.

I get the chance, as I travel across the country, to represent youth in agriculture, and I want to share with you one quick story before we conclude. That is, a special place that I have found off the coast of

Alaska. It is a special place called the Diomed Islands.

Why it is so special is because the International Date Line is found to run right down between the Diomed Islands. Not only that, but one side of the islands is owned by the Soviet Union and the other side is owned by the United States.

Not only does America need its young, but young people need your help, support, guidance, and leadership.

So you can sit on one side of the island and look across and it would be the 28th of the month, and on the other side of the island it would be the 29th. On a clear day, when you look across these islands, not only would you see another perspective on life, since the Soviets value the posses-

sions they have and we as Americans value freedom—but on a clear day you can even see tomorrow.

If you really think about that—the ability to see into the future—I wish I had the ability to see in the future right now because, let me tell you, I see a tremendously bright future in this industry of agriculture.

I am proud to say that I am a part of agriculture and proud to be here representing this organization, representing youth in agriculture. With that, I would like to leave you with one final statement on behalf of the youth, and that is that America needs youth because youth represents the future of the state of this country and of the existence of everybody. Not only does America need its young, but young people need your help, support, guidance, and leadership.□

THE ROLE OF PUBLIC POLICY IN AGRICULTURAL SAFETY AND HEALTH

Joseph A. Kinney, M.P.A.
Executive Director, National Safe Workplace Institute

Mr. Mark Timm: Our first speaker this morning is Mr. Joseph A. Kinney, Executive Director of the National Safe Workplace Institute, located in Chicago. Mr. Kinney spent his youth and entire professional career closely linked to agriculture. He grew up in Kansas working on farms and ranches and was deeply involved in breeding Charlette cattle when he was a college student at Illinois State University. Mr. Kinney holds a Purple Heart from service in Vietnam. He later spent five years working on agriculture in the United States Senate, and an additional five years as staff director for the committee on agriculture in the National Governor's Association. He spent a significant amount of time living and working with farm families in several states, including Idaho, North Carolina, Minnesota, Alaska, and California. He holds graduate degrees from the Maximal School of Citizenship and Public Affairs, and from the University of Pennsylvania. In 1987, Mr. Kinney founded the National Safe Workplace Institute, which is a not-for-profit organization devoted to making occupational safety and health a higher priority for the private and public sectors. Both Mr. Kinney's background and his interest in safety uniquely qualifies him to speak on the topic, *The Role of Public Policy in Agricultural Safety and Health*. Mr. Kinney:

Good morning. It is really a privilege for me to be here today to address the Surgeon General's Conference and to discuss the role of public policy in agricultural safety and health.

As you have just heard, I have had two careers. My first career was in agriculture. In fact, about 10 years ago or so I had the opportunity to address an agribusiness audience in Dallas, and one of the old ranchers in the audience got up and made a little speech and at the end of it he said, "And son, how long you been involved in agriculture?" I said, "Sir, 30 years. Next question, please." So, you know, I feel like I've been around it a fair bit of my life, since I was about 32 when I spoke in Dallas.

Throughout my life, I have developed a deep appreciation for the role that our farmers and ranchers play in the production of the food and fiber of this country. They clearly are our backbone. Without

them, we would have nothing. In fact, if you look at our economies and compare them with many of the economies in the industrialized world, one of the real strengths we have is our efficiency in food and fiber production. It is because of people like Mark. We all really owe them a lot.

As Mark said, I spent a lot of time living and learning from farmers and ranchers. I have cured tobacco in Harnett County, North Carolina. I used to be involved in all aspects of grain and livestock production in Illinois. Certainly I have baled my share of hay in Kansas. I have tended ranges in Wind River, in Wyoming.

My least favorite job was culling potatoes in Idaho. But I took those jobs because working in Washington, you tend to be sort of isolated and insulated from reality, and so when I would meet an interesting farmer I would ask him, "Well, can I come and

Questions to Guide the National Agenda

work for you for a week and learn what you do?" That is how I did it.

I actually was injured once. I had a very severe laceration to my left leg and was stitched by a "vet." When we design our surveillance systems, it is clear that we have got to include veterinarians because I was stitched by a vet. I have got a lot of ugly scars, but it is the ugliest. But it was a very valuable experience because it taught me that farmers like to rely on their own community. I would be very surprised if there is not some resistance to NIOSH.

► Certainly one of the things that I learned in my years in Washington was that the agricultural community is strongly resistant to OSHA. I think that will have to change. Clearly, farmers are a unique group. Farmers tend to work until the job is done. They do not know a 9-to-5 day. But it is also clear that agriculture defies easy generalization.

Throughout my life, and I am 42 now, there have been two consistent themes. The first is that our farms and ranches tend to grow in size, almost year by year. The little house on the prairie, near where I grew up in Kansas, now looks a lot more like Dallas.

► The second theme is that we are spending a lot of money—a significant amount of money—on supporting farm incomes from the Federal treasury. I think that is very important to understand, because I know farmers—and we will talk a little bit about this today—want to resist any kind of intrusions by external forces. But what farmers need to understand—and rural people need to understand—is that there is a significant public investment in what they do and, therefore, there is a significant

public interest in their health and well-being.

My interest in occupational safety and health stemmed from the death of my brother, Paul, from a scaffold collapse in Colorado. Since I have been involved, I have had a peripheral interest in agricultural safety. At the Institute, we have written about it. We have talked about it a little bit. We are doing a rather comprehensive analysis of options for public involvement on job safety. I will touch a little bit on that today.

Frankly, there would be more public involvement if it were not for the farm lobby.

You have heard plenty about the size and magnitude of this problem. You know, the National Safety Council puts out data and, based on this data, agriculture has had persistently high levels of injury relative to other regulated areas. I guess the lesson we could learn from that is that the free market and, perhaps, many educational approaches are not working. We need to look more aggressively to other approaches.

Frankly, there would be more public involvement if it were not for the farm lobby. Having met with many farm organizations, I can tell you that at least in the past they have resisted involvement. I think that is going to change. In fact, I think we will begin to see more public involvement in these issues in the near future. I mean involvement beyond the sort of touchy-feely things of education and beyond research issues. There are any number of areas that we could see develop.

I would like to show you a couple of transparencies that I put together here so we can get a sense of who is involved and what is involved. Farmers like to talk about target prices. People in public health like to talk about target groups.

When we look at this issue, we need to understand that there is more involved than the men and women who own and operate farm enterprises. There are children. There are farmworkers. There are all different categories of people.

Sector	Dollars Spent Per Worker
Agriculture	\$0.30
Mining Workers	\$181.68
Covered by OSHA	\$4.34

U.S. Department of Agriculture's Commitment to Agricultural Safety and Health, FY 1991:

- Extension Service—distributed on a formula basis with \$19,000 to each state: \$970,000
- Competitive Grant Program: \$1,000,000

Source: Prof. William Field, Purdue University.

Figure 1. Federal Dollars (Fiscal Year 1987) Spent on Occupational Safety and Health.

Now, potentially there are all sorts of laws that could be applied in this area—child labor laws, criminal prosecutions for not only fatalities and homicides, but batteries and injuries. There is obviously the possibility of citations. Right now there is a rider on the appropriations bill that keeps OSHA from inspecting injuries or fatalities on farms. Of course, there is Workers' Compensation, and, finally, there are injury lawsuits.

To this point the public involvement has largely been limited to research and education migrant protection, and health servic-

es. Of course, there is the sanitation standard. But the involvement of both states and the Federal Government has been quite limited.

1. Surveillance	\$5,745,816
► Farm Family Health and Hazard Survey.	
► Occupational Health and Safety Surveillance Through Health Departments.	
2. Research	\$6,217,817
► Applied Preventive Research.	
► Education and Training Programs.	
3. Intervention	\$6,676,367
► Cooperative Agreement Program for Agricultural Health Promotion Systems.	
► Demonstration Cancer Control Projects for Farmers.	

Source: NIOSH.

Figure 2. National Institute for Occupational Safety and Health—Agricultural Safety and Health Program.

In fact, if we look at Figure 1, we can see that these data are a little old; but, I am told by the producer of it, Bill Field of Purdue University, that the data really have not changed that much. As you can see, occupational safety and health expenditures equal about thirty cents per farmer. Perhaps that is what they think their lives are worth, but we spend a substantial amount of money, for miners, and a small amount of money for regular industrial workers.

The Agriculture Department's commitment is now essentially limited to a \$975,000 fund distributed equally to states. Perhaps we are going to hear that the U.S. Department of Agriculture (USDA) is also going to spend a million dollars in competitive grants that will be committed by the end of this fiscal year.

Figure 2 shows NIOSH programs that are multi-year programs. It looks like a lot of money. NIOSH spends \$18-\$19 million dollars. In reality, it is quite little.

In Figure 3 what we wanted to measure, in terms of budgetary expenditures, is the commitment that we have to occupational safety and health in America. Total federal workplace health spending involves the budgets for NIOSH, for the Occupational Safety and Health Administration (OSHA), and for the Mine Safety and Health Administration (MSHA).

In 1981, we spent one dollar out of each \$1,579 of the Federal budget for these programs—not very much. By 1991, that amount of money had dropped to just a one dollar out of each \$2,408.

Fiscal Year	Total Workplace Health Spending	Amount Required to Keep Pace with Inflation ¹	How Many Federal Dollars Spent for Each Dollar Spent on Workplace Health ²
1981	\$4,294	n/a	\$1,579
1983	\$4,165	\$4,854	\$1,941
1985	\$4,356	\$5,234	\$2,172
1987	\$4,524	\$5,493	\$2,219
1989	\$4,807	\$987	\$2,212
1991*	\$5,447	\$6,512	\$2,408

* Estimate.
¹ Inflation data based on calendar years; 1991 figure is an estimate.
² Another way of expressing this statistic: Number of federal dollars spent for every single dollar spent on the combined budgets of OSHA, MSHA, and NIOSH.
 Sources: Inflation Data—Bureau of Labor Statistics.
 Budget Figures—Office of Management and Budget.
 Compiled by the National Safe Workplace Institute.

Figure 3. Workplace Safety and Health Regulatory, Research, and Education Spending—Adjusted for Inflation and as a Share of Federal Budget, Selected Years (in millions).

What this chart represents to me is a diminished and decreasing commitment to workplace safety relative to other budget

priorities. There is no way around that. We have also looked at this and you know, we have looked at occupational health versus EPA; we have looked at this versus the National Institutes of Health and a lot of other measurements. Clearly, our commitment to occupational health in this country—workplace health—is going down.

Now in Figure 4, we looked at workplace health compared to the national defense.

Fiscal Year	Total Workplace Health*	National Defense	Ratio
1981	\$429.4	\$157,513	366.9
1983	416.5	209,903	504.0
1985	435.6	252,748	580.2
1987	452.4	281,999	623.3
1989	480.7	290,361	604.0
1991**	544.7	298,910 ***	548.8

*Includes combined budgets of the Occupational Safety and Health Administration, Mine Safety and Health Administration, and National Institute for Occupational Safety and Health.
 ** Estimate
 *** Pre-Desert Storm
 Source: Office of Management and Budget.
 Compiled by the National Safe Workplace Institute.

Figure 4. Comparison of Total Workplace Health Spending Versus National Defense Spending, Selected Years (in hundreds of millions of dollars).

In 1981, as you can see, we valued our national defense 367 times more than we valued the health and safety of workers in America. That is what these data say to me. By 1987, the ratio had grown to 623 times. In 1991, it dropped to 548 times. But, of course, that was before Desert Storm. No one seems to know what is going to happen to the defense budget. I think we are going to have to add somewhere in the neighborhood of \$40 billion plus. So, the 548 times figure will be much closer to 600 and something.

In fact, if you look on Figure 5, at workplace health spending compared to farm income stabilization, in 1981 we supported farm income 23 times more than we supported workplace health.

Please do not misunderstand what I am saying. I have worked hard on the farm bills of 1973, 1977, and 1981, and I certainly know all the arguments for target prices and price support loans and all the various USDA programs. I think they are very valuable. These are income transfers to farmers. Clearly, the dollar amounts fluctuate up and down depending on what commodity prices are doing, but nevertheless it is interesting to compare price supports and workplace health spending.

Fiscal Year	Total Workplace Health*	Farm Income Stabilization	Ratio
1981	\$429.4	\$ 9,783	22.8
1983	416.5	14,344	34.4
1985	435.6	21,323	49.0
1987	452.4	29,606	65.4
1989	480.7	14,817	30.8
1991**	544.7	9,761	17.9

*Includes combined budgets of the Occupational Safety and Health Administration, Mine Safety and Health Administration, and National Institute for Occupational Safety and Health.
**Estimate.

Source: Office of Management and Budget.
Compiled by the National Safe Workplace Institute.

Figure 5. Comparison of Total Workplace Health Spending Versus Farm Income Stabilization Spending, Selected Years (in hundreds of millions of dollars).

Figure 6 compares total workplace health spending to agricultural research and services of selected years, basically every other year from 1981 to 1991.

As you can see, the agricultural research and services budget is growing at a faster rate than workplace health. I was having breakfast this morning with some of my

extension friends and they were telling me how poorly the USDA agriculture research budget has been doing. My friends, you have been doing much better than NIOSH, OSHA, and MSHA, as you can clearly see in this Figure 6.

What these figures suggest to me, at least at a superficial level, is that there may be more room to do more things at USDA. Of course, that raises a significant question I hope will be worked out in the next year or two. The question is how we might best coordinate and work together. I think there is room for both agencies to be involved in this area. In fact, I think they already are. The Extension Safety programs go back a hundred years—a long, long time.

Fiscal Year	Total Workplace Health*	Agriculture Research & Services	Ratio
1981	\$429.4	\$1,540	3.6
1983	\$416.5	\$1,578	3.8
1985	\$435.6	\$1,813	4.2
1987	\$452.4	\$1,864	4.1
1989	\$480.7	\$1,964	4.1
1991**	\$544.7	\$2,404	4.4

*Includes combined budgets of the Occupational Safety and Health Administration, Mine Safety and Health Administration, and National Institute for Occupational Safety and Health.
**Estimate.

Source: Office of Management and Budget.
Compiled by the National Safe Workplace Institute.

Figure 6. Comparison of Total Workplace Health Spending Versus Agriculture Research and Services, Selected Years (in hundreds of millions of dollars).

The next figure, Figure 7, is what my four-year-old son would call a "big nasty." These are the kinds of public sanctions that can be taken against job-safety violators.

- First, if you look at the economic literature, the most costly part of OSHA's involvement with business is not in fines,

but clearly in the inspection process. There are many studies on that.

► Second, there are civil penalties, and they were recently increased by a substantial magnitude.

► Third, there are criminal penalties. There is legislation in the Congress now to increase the amount of time we can spend in jail for knowingly and willfully tolerating workplace conditions that result in the death of a worker. The government has recently put one person in jail, under the OSHA Act. It was a South Dakota contractor and the incident involved excavation fatalities. I have no idea how many people die in excavation fatalities on farms and ranches, but I am sure it is a substantial number.

► Fourth is Workers' Compensation premium increases.

► Fifth is a seldom-used tool, unfortunately. Hopefully, it will be used more in the future. It is simply an injunction to stop people from doing what they are doing.

► Sixth is the loss of eligibility to participate in public programs. The most recent example is that of a construction company called S.A. Healey, a Chicago company that had a bad safety record with many violations.

So far, they have lost a \$78 million contract in Los Angeles on which they are the low bidder in, because of their safety record. They lost a \$37 million contract in Milwaukee, where they were the low bidder, because of their safety record. They are the low bidder in an approximately \$200 million contract in another New Eng-

land state where my organization is actively trying to knock them out.

1. Potential target groups:

- Farmers.
- Farm Families (spouse, children).
- Farm Children engaged in farm work.
- Farm Workers, Permanent, Full-Time, Year-Round.
- Farm Workers, Permanent, Part-Time, Year-Round.
- Farm Workers, Seasonal, Part- or Full-Time.
- Migrants.

2. Applicable laws:

- Child labor laws.
- Federal criminal prosecution: homicide, willful violation.
- State homicide or battery prosecution.
- Citations for violations by the Occupational Safety and Health Administration or corresponding state agency.
- Workers' Compensation.
- Injury law suits.

— Compiled by the National Safe Workplace Institute.

Figure 7. Target Groups and Laws that Could Be Used To Regulate Agriculture Safety and Health.

One of the possibilities that we could see, frankly, in the agricultural area, is the possibility of cross-compliance. One of the models that we might look at in terms of public intervention and farm safety would be a farm safety audit.

If farmers did not pass their audits or make corrections within a specified period of time, they could lose eligibility for price support programs, soil-conservation programs, farm loan programs, farmers' home programs—whatever programs exist, and there are plenty of them.

Another area where I think we will see some intervention, very soon, of a criminal nature is children on farm equipment. Mark Timm talked about his involvement as a youth.

I could tell the same stories. One is a recent event; a 21-month-old was killed while helping his father when he fell under the wheel of a tractor that his six-year-old sister was driving. According to Bill Field, at Purdue, the fact that 300 kids die each year on farms—kids below the age of 15—is supported by a similar study at the University of Tennessee.

In recent years, we have documented three-year-olds who were killed in Nebraska and Texas who were actually classified as industrial deaths. Let me say one thing. This 300 number may be substantially larger in proportion to population than the numbers of 15-year-olds who are killed—murdered—in big cities because of drugs. If that does not make your blood boil, I think you should go out and have your temperature checked.

There is no way that anybody with half a conscience, looking at these numbers and looking at these stories, can sit and not say that this is not potential child labor abuse. We have been responding to increasing inquiries from prosecutors in various cities who have been looking into bringing child labor abuse charges in farm accidents. It has not happened, but I am certain that it will happen in the next few years.

Sunday there was a story on CNN—maybe many of you saw it—about a guy named Dominguez in Miami who is going to jail because his kid did not have a seat belt fastened. In fact, the kid was sitting in his mamma's lap, if I remember the story correctly. They had a crash, and the kid was

killed. So the father is being prosecuted. Frankly, there is not a dime's worth of difference, in my view, between the Dominguez in Miami and the man in Visalia, California.

The last area where I think there is going to be some involvement, as shown in Figure 8, has always been a dynamic area. There are only 12 states in the United States where farmworkers are recognized as workers under workers' compensation.

Coverage	States
Same as other	
Workers	Arizona, California, Colorado, Connecticut, Hawaii, Louisiana, Massachusetts, Montana, New Hampshire, New Jersey, Ohio, and Oregon (12).
Voluntary	Alabama, Arkansas, Idaho, Indiana, Kansas, Kentucky, Mississippi, Nebraska, Nevada, New Mexico, North Dakota, Rhode Island, South Carolina, and Tennessee (14).
Limited	Alaska, Delaware, Florida, Georgia, Illinois, Iowa, Maine, Maryland, Michigan, Minnesota, Missouri, New York, North Carolina, Oklahoma, Pennsylvania, South Dakota, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, and Wyoming (24)
—Compiled by the National Safe Workplace Institute with the Assistance of the Farmworker Justice Fund.	

Figure 8. Workers' Compensation Coverage of Agricultural Workers.

Workers' compensation is a no-fault injury program. When you create workers' compensation programs, you can not sue your employer for injury. Voluntary really means no program. I am sure—I do not have any studies but I am sure—that the vast majority of farmers in those states have no workers' compensation insurance. Are there any studies on this subject that you know of?

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About how many farmers have workers' compensation insurance in the states where it is voluntary? It would be a good study to do. In these other states—24 states—it is limited, like in Georgia. Farmers who work for the Department of Corrections are covered, but all other farmers are excluded. There are all sorts of different restrictions. We have all the data. We have analyzed the laws. That is the story!

Let me say that what we are now recommending to farmworkers who are injured, especially in the states with voluntary programs where there is no compensation coverage, is to sue. Sue the living "Bejesus" out of the farmer for whom you work.

This is the only way that we are going to get the attention of people in states where workers compensation is limited and farmers are not covered—sue. It is only recourse the injured have.

What has happened historically? To use the terms of economists, the economics of these injuries have been externalized. Who pays for injury in the case of the farmworker or migrant?

I can tell you who pays for it. It is the families. It is the local public charities. It is the public hospitals. It is not the farmer. And, of course, if the farmer can external

ize the cost and risk to other forces in society, it is rational for that farmer to do so.

I am not going to sit up here and just tell you exactly what is going to happen when and where. I do not know. But, believe me, it is moving toward public interventions. I hope what that says to each and every one of you out here is that you need to begin to get realistic about how you would like to see these issues addressed.

Our country spends more per capita for the education of the young than any other nation, save Switzerland. We spend lots of money to prepare young people for life. Cities help educate farm kids.

There is also public investment in human lives, and we need to do more to protect those lives in agriculture. I am sorry if some of you people feel, as my son probably would feel, that I have come and been the "big nasty" here today, but I think that it is time that we begin to look at this and realize that we have got to do something about farm safety.□

SURVEILLANCE FOR AGRICULTURAL SAFETY AND HEALTH

William E. Halperin, M.D.
National Institute for Occupational Safety and Health

Mr. Mark Timm: Our next speaker is Dr. William Halperin. He is the Associate Director for Surveillance, Division of Surveillance, Hazard Evaluation, and Technical Assistance, at NIOSH in Cincinnati. Dr. Halperin received his Master's in Public Health and M.D. from Harvard. In 1975 he became an Epidemic Intelligence Officer at the Centers for Disease Control. In 1979 he became the Chief of Industrywide Studies Branch at NIOSH. Dr. Halperin has served on numerous professional and expert committees. He currently serves on the Committee on Risk Assessment Methodology at the National Research Council. Dr. Halperin has published over 100 scientific papers, editorials, and letters to editors. His epidemiological investigations include herbicides, dioxin, and biotechnology. He was a co-author on perhaps the most popular paper in occupational health in the last 10 years—the *Sentinel Health Event: A Framework for Occupational Health Surveillance and Education*. That leads to Dr. William Halperin's topic today, *Surveillance for Agricultural Safety and Health*. Dr. Halperin:

Public health surveillance is central to the process of disease prevention. Surveillance systems are vital tools in targeting the resources of the public health system and in evaluating program effectiveness.

The Institute of Medicine report *The Future of Public Health*¹ found the core functions of public health to be assessment, policy development, and assurance of the availability of services. Surveillance is intrinsic to the assessment function and essential for proper policy development and assurance of service availability.

An ongoing national dialogue is needed on the role of public health education in training future public health professionals; graduates of schools of public health are acknowledging the need for more books and course materials designed to prepare students for public health practice. State and local public health agencies, in particular, have recognized this need as they recruit and hire new professional staff. There is growing recognition of the role of surveillance conducted by agencies of

government as well as by industry and labor to advance the mission of public health—"to fulfill society's interest in assuring conditions in which people can be healthy."²

Although surveillance is an essential element of the practice of public health, the subject is rarely taught in schools of public health or fully discussed in textbooks of public health or of epidemiology. This gap reflects the diverging cultures of public health between schools of public health and public health practitioners, a divergence recently addressed in a report of the Institute of Medicine, *The Future of Public Health*.

The essence of the motivation for public health was captured by the 16th century poet John Donne, who unfortunately came to the wrong conclusion about surveillance. Donne wrote:

No man is an island, entire of itself; every man is a piece of the continent, a part of the main. If a clod be washed away by the sea, Europe is the less, as well as if a

*promontory were, as well as if a manor of
they friend's or of thine own were: any
man's death diminishes me, because I
am involved in mankind, and therefore
never send to know for whom the bell
tolls; it tolls for thee.*

The public health sentiment is captured in the following line:

*Any man's death diminishes me,
because I am involved in mankind.*

This is not a matter of epidemiology or the technology of public health, but rather a matter of the philosophy that motivates public health action.

The antithesis of surveillance is captured in the following line: "Therefore, never send to know for whom the bell tolls." In earlier times, church bells were rung when people died. Currently we have a need for similar information to connect us to the burden of morbidity and mortality and to call forth public health practitioners so that deaths and morbid events can be investigated and recurrences prevented.

Surveillance in modern times is the equivalent of the tolling of the bells with the added commitment to investigation of the causation of morbidity and mortality and dissemination of data and analysis with the goal of prevention. Surveillance, as defined by Alexander Langmuir, the father of modern public health surveillance, and the founder of the Epidemic Intelligence Service of the Centers for Disease Control, "means the continued watchfulness over the distribution and trends of incidence through the systematic collection, consolidation, and evaluation of morbidity and mortality reports and other relevant data"^{3,4} for the purposes of prevention of disease or injury.

It is worth lingering over some of the key words in this definition. "Continued watchfulness" implies that the surveillance process continues over time, rather than being a one-time survey or epidemiologic study. Repeated surveys from which trends can be discerned are consistent with surveillance. "Collection, consolidation, and evaluation" should differentiate surveillance as a process from the important, but different enterprise of registering cases in a disease register, such as a cancer registry, if this registry does not include analysis of the data and dissemination of the results.

"Other relevant data" allows for collection of information on risk factors for disease, health or safety hazards, etc., or preventive interventions, such as immunization, rather than limiting surveillance to collection solely of data on disease. To differentiate surveillance from other useful collection of data, such as marketing surveys for a product, "for the purposes of prevention of injury and disease" should be added to Dr. Langmuir's definition.

Surveillance should not be so definitively defined that in-depth investigation of individual or sentinel cases is excluded. A "sentinel health event" represents a failure of prevention, such as a maternal death or an industrial injury.⁵

THE ROLE OF SURVEILLANCE IN PUBLIC HEALTH PRACTICE

The practice of public health can be defined as the logical application of methods of problem recognition, evaluation, and intervention for the purpose of prevention of disease and injury in populations. A working definition of epidemiology should reflect both the traditional broad notion that epidemiology is "the study of the distribution and determinants of disease

frequency in man,"⁶ which encompasses interest in epidemic and endemic diseases, as well the inclusion of the supplemental views of theoretical epidemiology. Theoretical or modern epidemiology focuses much more on the use of very sophisticated analytic methodology for understanding the relationship of risk factor and disease, particularly of endemic disease, rather than on the description of epidemics.⁷

Surveillance in modern times is the equivalent of the tolling of the bells with the added commitment to investigation of the causation of morbidity and mortality and dissemination of data and analysis with the goal of prevention.

A useful model that specifies the role of surveillance in the practice of public health has been developed by Greenwald,⁸ and further elaborated by Layde,⁹ and modified here to describe the role of surveillance in the prevention of occupational injury and disease.

- The first step in public health is the recognition of a problem; a related goal is tracking the trends of a problem as its incidence increases.

Sam Milham provides an example from the analysis of death certificates for industry and occupation.¹⁰ Usual industry and occupation is entered onto every death certificate; however, only in some states is it coded in order to be machine readable. From 1979 to 1987, about 2.9 million deaths were coded for industry and occupation in approximately 23 states.

In comparison to data purposefully collected for a research study, information from death certificates on industry and occupation and even cause of death will be collected without quality control, by minimally trained observers, and will inevitably contain errors. However, surveillance data, often collected for administrative purposes and secondarily used for disease prevention, is inexpensive and readily available.

Milham and colleagues found that farmers had a substantial excess in the proportion of deaths due to electrocutions. When the deaths were investigated, they found that many were due to contacting electric utility lines with portable aluminum irrigation pipe. While the association of electrocution and aluminum piping must have been evident to the sphere of people involved with each incident, the problem was only brought to the attention of the public health community by the analysis of minimal information available from death certificates, and the dissemination of results for the purpose of prevention.

Data from the Annual Survey of the Bureau of Labor Statistics¹¹ provide an example of tracking an occupational health problem as its incidence changes. The Annual Survey collects data from a sample of logs of injuries and illnesses kept by employers.

These data demonstrate an upturn in the numbers of cases of repeated trauma. Surveillance has done its job by disseminating information on this apparent epidemic to those with a need to know for the purpose of prevention. The related role of epidemiologic research necessary to determine the reality and etiology of this apparent epidemic should be evident.

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- The second step in the process of public health is the definition of the scope of a problem. Two examples reflect the value of ongoing collection of data in this endeavor and the usefulness of periodic surveys.

The first example concerns the surveillance of lead poisoning. In 16 states, laboratories report to the state health department if samples submitted for blood lead determination in adults are in excess of a state standard. This information provides a crude estimate for the burden of occupational lead poisoning for the United States, currently about 17,000 reports each year.¹²

A second example of the role of surveillance in providing an estimate of the scope of a problem comes from survey information periodically collected by the National Center for Health Statistics, Centers for Disease Control.¹³ From 1983 to 1987, successive periodic surveys provided information from approximately 2700 white, male farmers.

Farmers report 2.7 cases of skin cancer per hundred farmers. Nonfarmers report less than one case of skin cancer per hundred people.

Farmers have three-fold the amount of skin cancer than do nonfarmers. Thus, the periodic survey provides a crude estimate of the scope of the excess of skin cancer in farmers, in contrast to a research study that would likely include confirmation of each case, and which would estimate in substantially greater detail the exposure of the farmers, and would likely be designed to provide information on etiology or perhaps use of preventive measures.

- The third step in the public health process is to conduct etiologic research to determine the cause of a disease. This step consists of an epidemiologic study, not surveillance. For example, an epidemiologic study might be conducted to determine the differential exposure of cases of eosinophilia-myalgia syndrome as compared to controls without the disease. It does not require the ongoing collection of information about cases; rather, it requires more detailed information about cases occurring during the research period.

- Once an etiologic agent or exposure is identified, the fourth step in the public health process is the design of an intervention that will prevent transmission of the infectious agent, exposure to a chemical hazard, etc. Examples of intervention include immunization, withdrawal of a food contaminant, provision of a ventilation system, etc. This is not surveillance.

- The fifth step involves a trial of the proposed intervention system in an experimental situation where a limited number of important factors are carefully controlled. This type of public health experiment does not involve surveillance.

- Successful interventions in the controlled laboratory environment sometimes do not withstand the more rugged environment of the field test, the sixth step in the practice of public health. Surveillance can play a role in selection of field sites for testing.

- The seventh step in the public health process is targeting scarce preventive resources in order to maximize their effectiveness. A classic example comes from the eradication of smallpox.¹⁴ While the burden of smallpox was reduced by mass immunization, smallpox persisted because

there were sufficient unimmunized to sustain transmission. A turning point in efforts to eradicate smallpox came with the use of intensive surveillance for cases and the targeting of immunization to the contacts of cases.

Similarly, greater success in cancer prevention might be obtained if screening programs for breast cancer and cervical cancer were targeted to high-risk populations. Another example of the use of surveillance for targeting also comes from the surveillance of elevated blood lead based upon laboratory reports. Multiple elevated results from a single worksite almost insure that the work environment is in need of amelioration.¹⁵

- The eighth step in the practice of public health is the evaluation of the effectiveness of the public health intervention. Tracking the trends of disease is one mechanism for evaluating the effectiveness of intervention.

For example, in 1958, Sweden instituted a law that any new tractor that was produced had to have rollover protection.¹⁶ In the years thereafter, surveillance data indicate a decline in rollover fatalities. In 1978 Sweden instituted another law that any tractor in use had to have rollover protection, and the problem was eradicated.

CONCLUSION

There are four goals for surveillance. These include:

1. The identification of new occupational health problems.
2. The estimation of the scope or magnitude of the problem.
3. The delineation of the trend in incidence of the illness, disease, or hazard.
4. The targeting of opportunities for prevention.

Surveillance is a powerful tool in many parts of the complex continuum of practices that constitutes the public-health problem-solving process.

Epidemiologists have much to owe to the modern father of surveillance and field epidemiology, Alexander Langmuir, who in his wisdom commented, "Good surveillance does not necessarily ensure the making of the right decisions, but it reduces the chances of wrong ones."¹³□

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RESEARCH FOR AGRICULTURAL SAFETY AND HEALTH

James A. Merchant, M.D., Dr.P.H.

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Mr. Mark Timm: Our next speaker is Dr. James A. Merchant, Director of Agricultural Medicine and Occupational Health at the University of Iowa. Dr. Merchant received his B.S. from Iowa State University, his M.D. from the University of Iowa, and his Doctor of Public Health in epidemiology from the University of North Carolina. In 1968, he became an Epidemic Intelligence Officer at the Centers for Disease Control with an assignment to the North Carolina Board of Health. After this assignment, he served as Assistant Professor in Medicine at the University of North Carolina. In 1975, Dr. Merchant became Director of the Division of Respiratory Disease Studies at NIOSH. In 1981, he became and currently is Professor of Preventive and Internal Medicine at the University of Iowa. Dr. Merchant has published broadly in pulmonary medicine and epidemiology. His early work was in associating cotton dust exposure with byssinosis. He has published broadly on different lung diseases, which include problems with vegetable dusts and other organic dusts in agriculture, farmers' lung, and asthma. Dr. Merchant is active in professional organizations and in chairing and serving on expert committees at both the national and the international levels. Allow me to introduce to you Dr. James Merchant to speak on *Research for Agricultural Safety and Health*. Dr. Merchant:

ABSTRACT

In identifying research priorities for agricultural health and safety, one must first define the populations at risk. In agriculture, those at risk greatly exceed the number of farmers who report sole or primary employment from agriculture. Agricultural production is now changing dynamically, resulting in a substantial increase in farmers with non-farm jobs, greater involvement of women and seasonal workers, and involvement of children and recreational farmers in agricultural operations. All are exposed to some degree to multiple farm hazards—farm machinery, livestock, chemicals, organic dusts, and a wide variety of biological hazards. Priorities for research in agricultural safety and health include disease and injury surveillance; epidemiological investigations of morbidity, mortality and risk factors; studies of toxicological effects and mechanisms of disease; and the opportunity for meaningful intervention for disease and injury prevention. Those engaged in this research must also recognize the influence of poverty, limited access to health care, and limited insurance coverage among many living and working in rural areas. As the result of the national initiative in agricultural and environmental health, federal, state and foundation funding is now available to address these research priorities. The challenge is to maintain and cultivate these research opportunities through targeted research designed to advance our understanding and prevention of diseases and injuries among those with agricultural exposures.

THE POPULATION AT RISK

The population at risk to farming exposures is not known with precision. In 1980, some 2 million Americans reported prima-

ry employment in farming; 3.1 million reported some farm income; there were 2.7 million hired to do farm labor; and there were an additional 6 million farm-family members, some of whom did farm

work. But the number of full-time farmers is being reduced as agriculture moves dynamically to larger numbers of corporate farming operations, with greater numbers of part-time farmers and farmers with off-farm jobs, and more farm wives employed in both farm and off-farm jobs, while significant farm work is contributed by children under the age of 18.

A state-wide survey of Kentucky farms found 26 percent of farm men had off-farm jobs, 15 percent of farm women had off-farm jobs, and 23 percent with both farm men and women holding off-farm jobs.¹ Women's role in agricultural production has been largely ignored in the occupational literature, yet the proportion of women participating in the agricultural workforce has risen steadily from 11 percent in 1940 to 46 percent in 1980.²

In the University of Iowa Farm Family Survey of 1988 that included Iowa, Washington and New York states, 25-40 percent of women (depending on the state) were employed full-time in farming, and 45-55 percent were employed part-time in farming. Only 11-30 percent reported doing no farm work.³ In addition, 35-49 percent of the farm women surveyed were employed in off-farm work. Thus, many farm men face two work exposures (farm and off-farm job) while many farm women face three (farm, off-farm job, and home).

In addition to the occupational risks posed by the off-farm jobs, there is a significant additional risk of travel to and from the off-farm job on rural road-ways, often under poor driving conditions. As 64 percent of the nation's 48,700 motor vehicle deaths in 1988 occurred in rural areas, travel to and from work poses an additional occupational risk, which has often been

ignored in occupational health and safety research.⁴

There is even less information on the numbers of children at risk to agricultural operations. In the University of Iowa Farm Family Survey, the proportion of farms reporting children regularly doing farm work ranged from 18 percent (New York) to 23 percent (Iowa).³ It is recognized, however, that the number of children at risk to agricultural operations is much larger, as they are often exposed to farm machinery, buildings, and livestock while not engaged in routine farm work.

Migrant farmers are the most fluid population at risk in agriculture. The numbers at risk are not adequately defined, but it is known that migrant farmers assume some of the highest risks from exposure to agricultural chemicals, long hours, and some exposure to agricultural machinery, in addition to poor living conditions, limited—if any—insurance or health care, and often an additional risk of extensive travel over the harvest season.

Migrant farmers are especially challenging to study, as they are highly mobile, have variable exposures, and are a difficult population on which to obtain valid data because of language and legal barriers. Migrant farmers are, nevertheless, a very high priority for research because of their extensive exposures and other risks to health.

An additional population at risk in agriculture is the weekend or recreational farmer who typically farms a few acres using older farm machinery, often has some livestock, and often uses the same farm chemicals as full-time farmers. The number of weekend farmers is not known, but is increasing as

urban areas encroach on adjacent farm land.

Thus, the total population at risk to agricultural exposures is large, but the number is unclear—while the number of full-time farm workers appears to be decreasing, the total population at risk to agricultural operations may not be, given the diversity of multiple work roles of farm men, women, children, and migrant workers. Currently, there is no uniformity in classification of farm men, women, and children in regard to farm work and off-farm work. Clearly, development of such a classification would be useful for assessment of agriculture - related diseases and injuries among those living in rural America.

Therefore, four research priorities are:

1. To determine the distribution of farm men, women, and children and the total population at risk in agriculture.
2. To develop the best standard classification of farm men, women, and children, by on-farm and off-farm employment, that will provide the most relevant classification for health surveillance and epidemiological assessment.
3. To assess what additional occupational morbidity and mortality is attributable to off-farm work and to travel to and from off-farm work, and what the interactive effects of these multiple risks on disease and injury incidence are.
4. To determine, especially among migrant farm workers, what non-farming morbidity and mortality is attributable to living conditions, limited availability of health care delivery, and extended travel and what the interactions of these

factors and the multiple risks they face in agricultural work are.

These questions will be high priorities for the NIOSH Farm Family Health and Hazard Survey and should also be priorities for others engaged in health and injury surveillance and epidemiological studies of agricultural workers.

RESEARCH METHODS

Research approaches to agricultural safety and health may be divided into five broad research methodologies:

1. Basic Research (Toxicology and Mechanisms).
2. Disease and Injury Surveillance (Information Systems).
3. Epidemiological Studies.
4. Demonstration and Education Research (Intervention Studies).
5. Health Services Research.

Basic Research

Basic research is essential for adequate development of prevention strategies for agricultural safety and health. While this is less true for injuries, there is still a great need for basic research on the toxicology and mechanisms by which various agricultural exposures cause adverse health effects.

► One clear need for greater basic research is in the area of toxicological testing of agricultural chemicals, especially older pesticides that have not yet been tested for acute and chronic toxicity. This